

## Using In-Class Debates as a Teaching Tool

*Kenneth L. Alford<sup>1</sup> and John R. Surdu<sup>2</sup>*

**Abstract** — *In-class debates can be used as an excellent teaching tool in engineering courses. They can provide students the opportunity to synthesize course information, conduct related outside research, improve critical thinking, and develop verbal communication skills. When debate topics are sufficiently scoped, students are encouraged to tie together the major concepts of the course as they prepare their debate positions. The public nature of the debate format makes students naturally want to perform well. This teaching technique has been used successfully in computer science courses in the Department of Electrical Engineering and Computer Science at the United States Military Academy at West Point, New York.*

*Index Terms* — *Debate, education, engineering*

### INTRODUCTION

In-class debates can be used as an excellent teaching tool in engineering courses. Jones discussed a number of participative teaching techniques [1], debates among them, which can be used to teach computer science. Debates can provide students the opportunity to synthesize course information, conduct related outside research, improve critical thinking, and develop verbal communication skills. Debates can be an extremely flexible teaching tool. When debate topics are sufficiently scoped, students are encouraged to tie together the major concepts of the course as they prepare their debate positions. The public nature of the debate format makes students naturally want to perform well. As a result, students often willingly spend additional time in order to be well prepared.

Debate topics should be broad and controversial, if possible, to persuade students to evaluate not only their own viewpoint, but other possible viewpoints as well. In addition, the requirement to succinctly state and support their arguments requires students to hone their verbal communication skills.

There are several in-class debate formats that can be used: (1) student team vs. student team, (2) student team vs. faculty team, and (3) faculty team vs. faculty team. Each format has its own advantages and possible disadvantages – which will be discussed in this paper. This teaching technique has been used successfully in computer science courses in the Department of Electrical Engineering and

Computer Science at the United States Military Academy at West Point, New York.

### HOW DEBATES AUGMENT CLASSROOM INSTRUCTION

Classroom debates can be an excellent way to encourage students to learn. For example, they can:

- Help students organize and synthesize information (similar to a thorough term end examination study period)
- Encourage students to learn on their own (similar to a serious research paper)
- Increase student cooperation skills (similar to a successful student team project)
- Improve verbal skills (similar to other good, in-class student presentations)

### WHAT MAKES A GOOD DEBATE TOPIC?

Stated simply, a good debate topic is any topic that increases student knowledge, causes them to think, and helps them learn. Besides increasing subject matter expertise, a good debate topic can also help students improve their critical thinking, organizational, and verbal skills.

A good debate topic has numerous clear and compelling arguments available for both sides to present. There must also be sufficient information available through research to support both opposing viewpoints.

The selection of a good debate topic is also partially dependent upon the timing of the debate itself. Debates scheduled near the beginning of the course should be less technically oriented than debates scheduled near the end of the semester. It is generally recommended to hold debates near the end of the semester so that students can call upon all of the information they have learned throughout the semester.

When measured against a course syllabus and student knowledge, possible debate topics fall into three broad categories: (1) topics discussed in depth during the course of the semester, (2) topics discussed briefly during the semester, and (3) relevant topics not taught or discussed during the semester.

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### Topics Discussed in Depth

Debate topics selected from this category represent the key concepts and major themes that are taught within a course. For example, in a computer science programming languages course, this category of topic might deal with typing or the allocation of memory. In an Artificial Intelligence course, appropriate in depth topics may refer to search strategies or the possibility of computer programs becoming self-aware.

These are usually the kinds of topics that have been addressed directly throughout the course and have been discussed during numerous lessons, reading assignments, and possibly through various graded events.

The advantage of selecting a topic of this nature is that it encourages students to organize and synthesize the course material that they have received and experienced throughout the entire semester. It should help them see the commonalities and the differences each time the topic was discussed as part of the course. A second advantage is that it does not require as much outside student preparation and research effort as the other categories of topics. Ironically, this is also the primary weakness of this category because it does not encourage students to develop their own research skills as they search for new information.

### Topics Discussed Briefly

These are important topics in the subject matter that the time available during the semester did not support their thorough discussion or investigation. Assigning a topic from this category can help round out general student knowledge in an additional relevant subject area.

An advantage of assigning this kind of topic is that students already have a basic understanding of some of the key concepts and issues pertaining to the topic before they begin their research. Course materials, textbooks, and lecture notes can also give them a head start on their research and point them in a useful direction. Yet, at the same time, a second advantage is that it requires students to dig deeper into the topic in order to debate it. There are no major disadvantages to selecting a topic from this category.

### Topics Not Discussed

Engineering fields continue to expand at a dizzying pace. It is becoming more difficult to remain current in ever-decreasing specialized bodies of knowledge. This pressure is also felt in engineering classrooms as instructors attempt to provide a well-balanced treatment of their subject matter each semester.

Topics in the third category are selected from among the many, many concepts, issues, and subjects that are always "left over" after a course syllabus is completed each semester. Selecting debate topics from this category allows you to familiarize your students with at least one of those topics. By using the debate format, students can learn more

than if you spent an hour in lecture or discussion on that topic.

The main advantage of this category is that it encourages students to apply the knowledge and skills gained in your course to a related topic area, but one that is new to them. A possible disadvantage is that students may miss or misunderstand some of the key questions and issues in this new topic area.

## STRATEGIES FOR ASSIGNING DEBATE POSITIONS

After a debate topic is assigned, there are several strategies that can be used to assign affirmative and negative debate positions to each team. We will discuss three possibilities.

### Assign Debate Position Initially

Under this scenario, students receive their affirmative or negative debate position at the same time they receive their debate topic assignment. For example, a computer science programming language debate topic could be assigned as follows: "Be prepared to effectively argue FOR the position that 'Ada should replace Java as the standard language in undergraduate computer science programs.'"

This strategy has the potential to save students' time because they will only have to thoroughly prepare half of the debate topic. The main disadvantage of this strategy is that it does not adequately encourage students to evaluate and critically think about both sides of the question under consideration.

### Assign Debate Position Later

With this strategy, instructors do not reveal to debate teams whether they will be arguing the affirmative or negative side of their specific debate question. With this strategy, the computer science programming language debate topic would be assigned as follows: "Be prepared to effectively argue FOR or AGAINST the position that 'Ada should replace Java as the standard language in undergraduate computer science programs.' You will be told several days prior to the debate which position you will argue at the debate. Notification will be by email."

When using this strategy, it is recommended that you inform students of their debate position anywhere from several days to several weeks before the debate, depending on your situation.

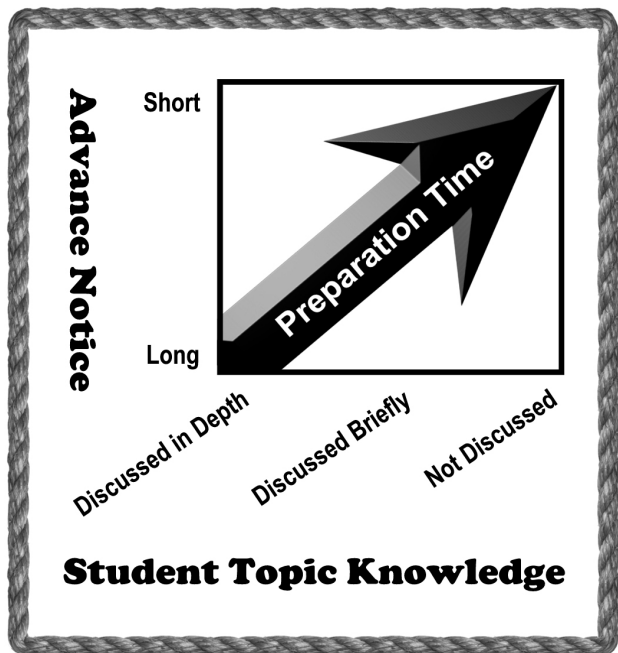
This strategy has the advantage of encouraging students to honestly evaluate and prepare arguments both for and against the question under debate. It has the possible disadvantage, though, of encouraging students to procrastinate, if they hope they can wait until they find out their specific position before they begin serious preparation. This disadvantage can be partially ameliorated by not revealing in advance the exact date when debate positions will be announced.

**Assign Position “at” the Debate**

The last and clearly most difficult strategy, but also potentially the most rewarding for students, is to assign the debate topic and wait until the date of the debate itself before announcing affirmative and negative positions. The amount of advance notice can vary from a minimum of 30 minutes to several hours based on the difficulty of the topic and student circumstances.

The computer science programming language debate topic could be assigned as follows: "Be prepared to effectively argue FOR or AGAINST the position that ‘Ada should replace Java as the standard language in undergraduate computer science programs.’ You will be assigned your debate position one hour prior to the beginning of the debate. Notification will be by email and also by a message posted on the classroom door.”

Like the strategy previously discussed, this strategy encourages students to seriously evaluate the entire debate topic. It has the added advantage of requiring students to prepare initial argument positions for both sides of the question, and it substantially reduces the incentive for students to procrastinate their preparation. The primary disadvantages of this strategy are that it requires substantially more student preparation time, and student team members may not have similar class schedules that will enable them to meet and prepare on the actual day of the debate.



**Figure 1. Relationship between advance notice, initial student knowledge, and preparation time.**

As shown in Figure 1, the amount of debate preparation time required by students is a function of the amount of time that students are given advance notice of the position they must defend during the debate and the amount of initial knowledge and familiarization that students have with the actual debate topic.

**COMPUTER SCIENCE DEBATES AT WEST POINT**

Debates have been used in humanities courses for many years. This paper makes the case that debates have a place in engineering courses as well. To illustrate this point, the use of debates in the Introduction to Artificial Intelligence (AI) course at the United States Military Academy is described.

Introduction to Artificial Intelligence is an upper-level elective, usually taken by seniors. The course is a breadth-based introduction, covering traditional AI, heuristic search techniques, predicate logic, genetic algorithms, expert systems, artificial neural networks, and intelligent agents. The course covers a combination of theory with hands-on programming of heuristic search, expert systems, and artificial neural networks.

It is not immediately apparent how debates would find a home in such a course. But, in fact, the “Great AI Debate,” that is conducted during one of the last lessons of the semester, has been an integral part of the course for the past three years.

In previous years the AI Debate has involved a student team debating another student team. In the fall of 2001, a student team debated against a faculty team. (The strengths and weaknesses of these approaches are discussed in the next section of this paper.) In both cases, the debate question was the same: “Should the goal of AI be the creation of a thinking machine?” Teams were randomly assigned affirmative and negative sides of this argument. In the student team vs. student team format, students were also assigned randomly to their debate teams.

The debate topic statement is sufficiently broad and controversial to make the debate an interesting intellectual exercise.

The general structure of the debate (without cross-examination) can be as follows:

- A coin toss immediately prior to the debate determines which team began the debate.
- The team that wins the coin toss begins with five minutes for stating an opening position.
- The other side then has 3 minutes to present their opposing position.
- The original side receives 2 minutes for rebuttal.
- The other side then receives one minute for counter-rebuttal.
- The timing for the next round is the same as the first except that the teams switch the order of their presentations.

Two possible debate formats are shown at Figures 2 (without cross-examination) and 3 (with cross-examination). Both formats are designed to take the 15 minutes for one round, and it is recommended that a classroom debate consist of two rounds which usually leaves sufficient time for discussion and audience comments.

Because of the public nature of the debate, students prepared diligently for the debate. A large stack of reference material was provided in the department library for their use. Students were also encouraged to do outside research as well. The students' level of preparation for the debate was well in excess of their level of preparation for most classes during the semester.

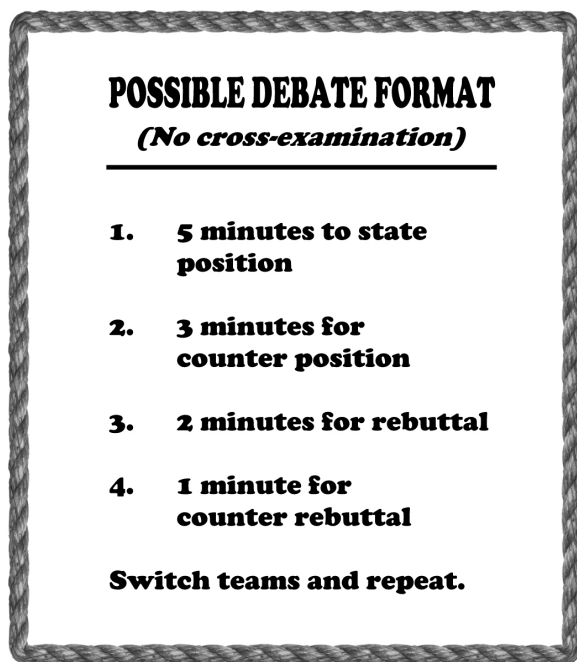


Figure 2. Debate Format (without cross-examination)

The debate began with both sides attempting to define intelligence [2] and learning [3] in such a way that it set the stage for their later positions. The debate quickly moved on to the Turing Test [4] and Searle's Chinese Room anecdote [5, 6]. It was gratifying to see the other group of students counter the Chinese Room argument with Churchlands' Luminous Room argument [7]. At this point it is important to note that none of these papers was "assigned" reading. The debate format had enticed the students to read and study them on their own.

At this point, the debate focused on whether creating a thinking machine is possible, not whether the goal of AI should be a thinking machine. In several iterations of The Great AI Debate, the debate rapidly moves down one of two paths:

- Scare tactics on the part of the negative position about machines taking over the world and determining that people are no longer needed, or
- Metaphysical arguments that the goal itself drives innovation and progress even if it is never reached.

The debate usually concludes with the group that is debating in favor of this goal illustrating many possible benefits of thinking machines to mankind. It is interesting to hear how many innovative ideas 21-year-olds can dream up in support of this argument. At the same time, the group arguing against the proposition refutes that any of these proposed applications involves real thinking.

The debate concludes with each team being given three minutes for closing remarks. When the last speaker has presented the team's closing remarks, the audience can be asked to vote for which team presented the most convincing argument, if desired.

Grades for classroom debates can be based on numerous factors, such as preparation, organization, quality of arguments, presentation, continuity between team members, etc.

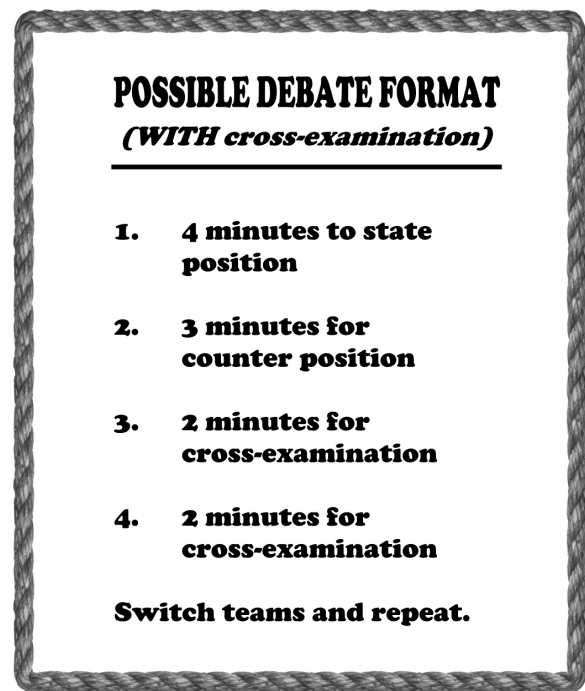


Figure 3. Debate Format (with cross-examination)

#### ALTERNATIVE DEBATE FORMATS

Many formats can be used to conduct in-class debates. The three typical team patterns to choose from are: student team vs. student team, student team vs. faculty team, and faculty

team vs. faculty team. Each format has advantages and disadvantages.

In addition to determining debate format, instructors can also decide if they would like to allow debate teams to cross examine each other during portions of the debate, or if they would prefer to conduct the debate without any cross-examination -- in a presentation mode only.

#### **Student Team vs. Student Team**

When student teams debate each other, it is important to make the teams as balanced in ability as possible.

The primary advantage of a "student team vs. student team" debate is that students tend to feel that they are debating on a level playing field. Some students may feel discouraged and at a severe disadvantage if asked to debate faculty members.

Possible disadvantages of students debating each other is that they may be tempted to collaborate prior to the debate or may not take the debate as seriously as they would if they were debating faculty members.

#### **Student Team vs. Faculty Team**

The advantage of having the students debate a faculty team is the level of effort put forth by the students. Students, fearing that the faculty may overpower them, often redouble their efforts to prepare for the debate. We have found that our students, motivated by a desire to avoid embarrassment, prepared very well for debating against the faculty.

This is our favorite classroom debate format.

#### **Faculty Team vs. Faculty Team**

Faculty team vs. faculty team debates can also be used as an additional teaching tool. They have the advantage of enabling students to view topics and issues from conflicting viewpoints, but they also have the important disadvantage that students will not learn nearly as much as they would from having researched and wrestled with the topic themselves as they determine and develop arguments to support their position.

This is our least favorite format for a classroom debate.

### **CONCLUSION**

As a pedagogical tool, debates can encourage students to tie together many threads that have been woven through their course during the semester. Debates can also serve as an excellent teaching tool to introduce new topics in a course or to build upon topics only lightly treated earlier during the semester.

In the example of the AI course, students were forced to support their chosen definitions of intelligence, thinking, and learning. Throughout the semester, the students had been exposed to many disparate concepts. They had questioned whether heuristic search, frame based reasoning, rule-based

systems, and artificial neural networks really constituted intelligence.

During the debate an observer can watch the students synthesize the theory with what they have learned through hands-on exercises. The result is an experience for the students akin to an epiphany.

Classroom debates can be an extremely effective teaching tool for engineering courses.

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